

# A High Efficiency 30 K Cryocooler with Low-Temperature Heat Sink, Phase II Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)



## ABSTRACT

Future NASA planetary science missions have very limited access to solar power and therefore reducing the cryocooling system power input is even more critical than for earth-orbiting satellites. On this program, Creare proposes to develop and demonstrate an innovative Stirling cryocooler that efficiently produces refrigeration at 30 K and rejects heat at about 150 K. A key component of the proposed cryocooler, its regenerator, will be optimized on this program to obtain high efficiency over this operating temperature range. The innovation is a regenerator fabricated by a unique process to enhance its heat capacity near its target cooling temperature and, therefore, increase the overall thermal efficiency of the cryocooler. The proposed cryocooler is built on technologies developed for commercial Stirling cryocoolers that are extremely compact and efficient while rejecting heat at 300 K. In Phase I, we proved the feasibility of our approach by demonstrating the regenerator fabrication process and its high heat capacity near 30 K, and showing the high thermal efficiency of the 30 K cooler by design and analysis. In Phase II, we will fabricate a Stirling cryocooler that incorporates the regenerator with high heat capacity, optimize the cooler, and deliver the cryocooler to NASA for further performance characterization at the end of the program.

## ANTICIPATED BENEFITS

### To NASA funded missions:

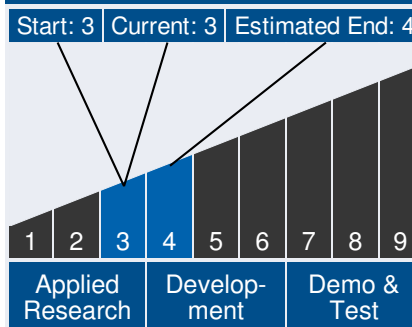
Potential NASA Commercial Applications: The successful completion of this program will provide mission planners with a high performance, lightweight, and compact cryocooler that can meet requirements for a variety of missions. The cryocooler is efficient, reliable, and low cost. NASA applications include cooling MgB2 thin-film bolometers for applications in far-infrared instruments, sensors, shields, and telescopes for planetary science missions, as well as cooling for cubesats.



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## Technology Maturity



## Management Team

### Program Executives:

- Joseph Grant
- Laguduva Kubendran

### Program Manager:

- Carlos Torrez

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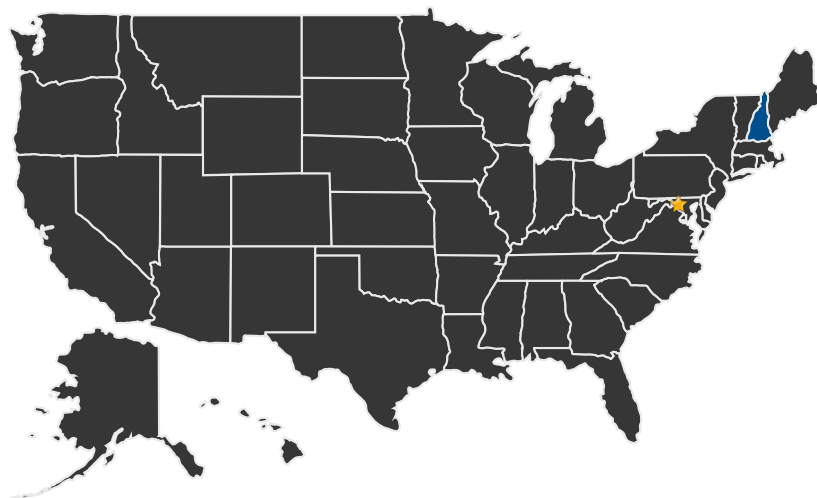
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## To the commercial space industry:

Potential Non-NASA Commercial Applications: The proposed cryocooler requires minimal input power and is extremely compact making it ideal for small satellites. Military space applications for this cooling system include space-based surveillance for Operationally Responsive Space missions. Commercial versions of the cryocooler will operate at rejection temperatures of near 300 K with heat lift at temperatures of and below 30 K, a temperature range that is currently unachievable with commercial Stirling cryocoolers.

## U.S. WORK LOCATIONS AND KEY PARTNERS



■ U.S. States  
With Work

★ **Lead Center:**  
Goddard Space Flight Center

## Other Organizations Performing Work:

- Creare, LLC (Hanover, NH)

## Management Team (cont.)

### Principal Investigator:

- Weibo Chen

## Technology Areas

### Primary Technology Area:

Science Instruments,  
Observatories, and Sensor  
Systems (TA 8)

- └ Remote Sensing Instruments  
and Sensors (TA 8.1)
- └ Cryogenic / Thermal (TA  
8.1.6)

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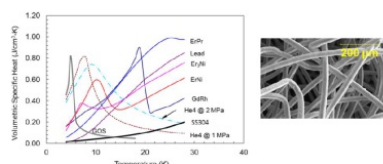


## PROJECT LIBRARY

### Presentations

- Briefing Chart
  - (<http://techport.nasa.gov:80/file/23383>)

## IMAGE GALLERY



Innovative Rare-Earth Regenerator Used to Enhance Cryocooler Performance at Low Temperatures

*A High Efficiency 30 K Cryocooler with Low-Temperature Heat Sink, Phase II*

## DETAILS FOR TECHNOLOGY 1

### Technology Title

A High Efficiency 30 K Cryocooler with Low-Temperature Heat Sink, Phase II

### Potential Applications

The successful completion of this program will provide mission planners with a high performance, lightweight, and compact cryocooler that can meet requirements for a variety of missions. The cryocooler is efficient, reliable, and low cost. NASA applications include cooling MgB2 thin-film bolometers for applications in far-infrared instruments, sensors, shields, and telescopes for planetary science missions, as well as cooling for cubesats.